Kilopower - powering NASA's missions on Mars

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When we imagine sending humans to live on Mars, the moon or other planets in the not-so-distant future, a key question is: what kind of power source is small yet potent enough to reliably power an extraterrestrial habitat, and also make fuel for the trip home?

Leaving Earth with enough fuel for a return journey from Mars for example would make the spacecraft too heavy, so there needs to be a power source on the destination planet to make liquid oxygen and propellant.

Researchers at Los Alamos National Laboratory in conjunction with NASA have come up with a potential solution, known as Kilopower: a small nuclear reactor that may one day power a colony on Mars, the moon or beyond.

"As we look to the future, the potential for nuclear energy to bolster plans for a long-term habitat on other planetary bodies is pretty extraordinary," says Patrick McClure, Los Alamos National Laboratory project lead for Kilopower.

Simple and lightweight

The strength of Kilopower lies in its simplicity: the nuclear reactor generates heat, and then heat-pipe technology (invented at Los Alamos National Laboratory in 1963) is used to power a Stirling engine.

This creates a lightweight and reliable electric power supply with few moving parts that can be adapted for space applications, including human exploration and space science missions to the moons of Jupiter and Saturn.

Kilopower reactors range in output from 1 kilowatt — about enough to power a household toaster — to 10 kW. Running a habitat and creating sufficient fuel on Mars would require about 40 kW, so NASA would likely send four to five of the reactors to the planet's surface.

Other energy sources either require too much fuel — making them too heavy — or can't be counted on in all seasons. Solar power, for example, relies on consistent sunlight, which Mars cannot offer in part because of the planet's dust storms, which can last for months.

What's next?

Experiments to test Kilopower began in late 2017 at the Nevada National Security Site and included the test of a flight-like reactor core at full operating temperature.

"While powering a colony is only one of the many complex technical questions that must be answered when we think about sending humans to other planets, it's a critically important one," says McClure. "Kilopower could very well be the answer. We're excited to see where it will take us."

—- McClure and chief reactor designer David Poston will be discussing the Kilopower project in the Frontiers in Science public lecture series in Albuquerque, Los Alamos and Santa Fe starting April 2.